

A computational method for selecting service quality factors considering the representative models

Vahid Godazgar ^{1*}, Norihan Bte Abu Hassan ¹, Elham Majd ², Dr. Hayati @ Habibah Binti Abdul Talib ²

¹*Perdana School of Science, Technology, and Innovation Policy/ University Technology Malaysia, Kuala Lumpur, Malaysia*

²*Department of Information Sciences/ University of Malaya, Kuala Lumpur, Malaysia*

Abstract: This paper aims to propose a computational method for comparing different service quality measurements that plays the critical roles in the automobile industry. Finding the critical items to measure service quality led to increase customer satisfaction. Hence different industries intend to find these critical factors to enhance the competitive advantage and profitability. However, there are several service quality models which presented different items, the notable problem is that how a specific industry selects the most appropriate models which presents the all critical factors. This paper collects the all critical factors for measurement service quality from the most representative models in automobile industry. Then the all collected items from these models are rated by experts. The rate of each item is weighted using Lawshe's content validity ratio method. Finally, a multi criteria decision making process is applied to select the most appropriate measurement model in service quality based on the weighted items of these models. The result lead to select the most appropriate service quality model in automobile industry, in addition of identifying a critical measurement items for service quality based on Lawshe's content validity ratio method. This study helps researchers to compare different measurement models and determine essential items. The proposed method also supports industries to increase their customer satisfaction, enhance purchase intention and improve profitability with measuring the quality of their services accurately.

Key words: Service quality measurement; Computational method; Automobile industry; TOPSIS; Lawshe

1. Introduction

Quality has been defined differently by several researchers. Some outstanding definitions include 'conformance to requirements' (Crosby, 1984), 'fitness for use' (Juran, 1988) or 'one that satisfies the customer' (Langeard & Eiglier, 1987). According to Japanese production philosophy, quality implies 'zero defects' in the firm's offerings. Though initial efforts in defining and measuring service quality emanated largely from the goods sector, a solid foundation for research work in the area was laid down in the mid-eighties by Anantharathan Parasuraman, Zeithaml, and Berry (1985). Against the goods sector where tangible factors exist to enable consumers to assess product quality, the service quality context is explicated in terms of parameters that largely come under the domain of 'experience' and 'credence' properties which are difficult to measure and assess (Jain & Gupta, 2004; Zeithaml et al., 2006).

Studies on service quality have taken an important role in services marketing over the last three decades. From the primary studies of early researchers (Grönroos, 1984; Anantharathan Parasuraman et al., 1985), attention to the issues of modeling, measuring, and managing service quality have grown exponentially (Rust Roland & Oliver,

1994). Defining and measuring the service quality conception is the vital importance issue. Two decades ago, this issue has been stated as how service quality should be measured (Cronin Jr & Taylor, 1994; Dabholkar et al., 2000). Part of this controversy revolved around the validity and reliability of SERVQUAL (Anantharathan Parasuraman et al., 1985) and the service dimensions which best predict consumers' overall preferences and perceptions of service quality (Strombeck & Shu, 2014).

Despite considerable work undertaken in the area, there is no consensus yet as to which one of the measurement scales is more appropriate for measuring and comparing service quality. The major problem with past studies has been their concern with evaluating psychometric and methodological soundness of service measures in the context of service industries in the developed countries. Practically no empirical efforts have been made to consider the diagnostic ability of the factors in providing managerial perspectives for corrective activities in the event of service quality measurement shortages. In addition, for comparing the service quality measurements, it is needed to compare these measurements in the same industries. In this case, this paper proposes a computational method for comparing different service quality measurements in automobile industry. Little work has been done to investigate

* Corresponding Author.

the appropriateness of these factors to the service quality in automobile industries.

2. Theoretical background

In this section, first of all, the 3 representative models will be introduced. Next, the items of these models will be presented in matrix D as a Decision Matrix. Finally, based on expert choice the most appropriate items of each model will be selected.

Model (PZB)[†]: SERVQUAL is a scale applied to "measure and improve service quality in a variety of industries" ([Gonzalez, Mueller, & Mack, 2008, p230](#)). Also known as RATER, SERVQUAL is a service quality framework frequently utilized to service based industries. This research instrument was developed in the mid-1980s by [A Parasuraman, Zeithaml, and Berry \(1988\)](#). The instrument originally contained 10 dimensions employed to measure service quality, but it was later scaled down to 5 dimensions ([A Parasuraman et al., 1988](#)).

- Tangibles: Physical facilities, equipment, and appearance of personnel
- Reliability: Ability to perform the promised service dependably and accurately
- Responsiveness: Willingness to help customers and provide prompt service
- Assurance: Knowledge and courtesy of employees and their ability to inspire trust and confidence
- Empathy: Caring, individualized attention the firm provides its customers

Several articles are utilized the SERVQUAL survey instrument such as airline service ([Chou et al., 2011](#); [Pakdil & Aydin, 2007](#)), healthcare ([Muhammad Butt & Cyril de Run, 2010](#); [Roshnee Ramsaran-Fowdar, 2008](#)), banking services ([Lassar et al., 2000](#); [Rod et al., 2009](#)), and financial ([Sohn & Tadisina, 2008](#)).

There are a considerable number of references available to measure and understand service quality. In this regard, to criticize the SERVQUAL instrument, several articles by [Cronin Jr and Taylor \(1992\)](#), and Teas (1993), provided a great deal of information about this issue. [Cronin Jr and Taylor \(1994\)](#) implied the issue of the appropriateness of SERVQUAL as one-sided, which did not support the performance-based paradigm of service quality. They believed that SERVPERF model raised by Cronin and Taylor offered better conceptualization and operationalization of the service quality construct. They argue that the concept of service quality should be customers' attitude towards the service. An attitude based conceptualization would argue for either an importance-weighted evaluation of performance on specific service attributes.

Although both of these methods, SERVQUAL and SERVPERF utilize the same 22 items for measuring service quality but the ways that used to measure are different. The SERVQUAL method represents the Eq. 1, but the SERVPERF model utilizes the f Eq. 2:

$$SQ\ SERVQUAL = I * (P - E) \quad (1)$$

$$SQ\ SERVPERF = I * P \quad (2)$$

Where, SQ shows Service Quality, P denotes Performance, E represents Expectation, and I is Importance. However, in this study the method of considering is based on the items which measure the service quality construct, therefore, it is needed to investigate these items. [Yan and McLaren \(2010\)](#) utilized and adapted SERVQUAL method to measure service quality of automobile industry. They report on a measurement of the service quality within a dealership in the Western Cape Province, South Africa. A case study was conducted at the unit using five dimensions of SERVQUAL to examine the gap differences between customers' expectation and perception of staff from the dealership (Matrix D).

Model (Y&G)[‡]: [Yun and Guo-ping \(2012\)](#) published the paper which introduces the definition of service quality, the discrepancy analytical model, and the service profit chain of automobile industry based on the generalization of current service quality situation of automobile 4S stores in China. Their research classifies 3 sub-variables of service quality based on [Grönroos \(1984\)](#) and uses 12 items to measure it. They utilized AHP and fuzzy synthetic evaluation methods to analyze the evaluation indices system, and establish a set of evaluation model for measuring the service quality of automobile 4S stores. Finally, they use practical calculation process to show the validity and applying capability of this evaluation model, and provide valuable benefits to enhance the service quality of automobile 4S stores. In this regards, they define some factors to measure service quality of automobile (Matrix D).

Model (D&J)[§]: [Dai and Jiang \(2012\)](#) consider the after-sales service quality of 4S shops. They introduced the constructing the evaluation system of after-sales service quality of cars and applying solution model of AHP-BP neural network. In their study, 15 items in 5 classifications are offered to measure service quality of automobile (Matrix D). Next they utilize the Expert Scoring Method which can establish discriminant matrix of level indicators. Finally, they treat each index data by averaging, and get standardization of the each index date.

3. Methodology

Various models proposed for measuring service quality, so this is very beneficial to study which of these models are more appropriate and successful in measuring the service quality. This research is based on different multi-criteria decision making methods for selecting the presented measurements of service quality. There are a variety of multiple criteria techniques to aid selection in conditions of multiple criteria ([Olson, 2004](#)). One of the methods is Technique for Order Preference by Similarity to Ideal Solution "TOPSIS". The advantage of TOPSIS is the ability to identify the best alternative ([Parkan & Wu, 1997](#)). In fact, TOPSIS is a suitable method for

[†] PZB Model was proposed by Parasuraman Zeithaml and Berry

[‡] Y&G Model was proposed by Yun and Guo-ping
[§] D&J Model was proposed by Dai and Jiang

finding the best option among different options where each option is based on several criteria.

TOPSIS was initially presented by [Hwang, Paidy, Yoon, and Masud \(1980\)](#), [Lai, Liu, and Hwang \(1994\)](#), and [Yoon and Hwang \(1995\)](#). The TOPSIS procedure consists of the following steps:

(1) Calculate the normalized decision matrix, as:

$$ND_{ij} = f_{ij} / \sqrt{\sum_{j=1}^J f_{ij}^2} \quad j=1, \dots, J; \quad i=1, \dots, I \tag{3}$$

Where, ND_{ij} shows the normalized value of decision matrix and f_{ij} shows the matrix elements.

(2) Construct the weighted matrix

(3) Compute the weighted normalized decision matrix, as:

$$V_{ij} = ND_{ij} \times W_j \quad j=1, \dots, J; \quad i=1, \dots, I \tag{4}$$

Where, V_{ij} shows the normalized weighted matrix, W_j is the weight of the j th attribute or criterion, and ND_{ij} represents the normalized decision matrix

(4) Determine the positive ideal solution and negative ideal solution.

$$A^* = \{v_1^*, \dots, v_n^*\} = \{(Max_j v_{ij} | i=1 \dots I)\} \tag{5}$$

$$A^- = \{v_1^-, \dots, v_n^-\} = \{(min_j v_{ij} | i=1 \dots I)\} \tag{6}$$

where, A^* shows the positive ideal solution, I^+ is associated with positive ideal criteria, A^- denotes the negative ideal solution, and I^- is associated with n criteria.

(5) Calculate the separation measures, using the N-dimensional Euclidean distance. The separation of each alternative from the ideal solution is given as:

$$D_j^* = \sqrt{\sum_{i=1}^n (v_{ij} - v_i^*)^2} \quad j=1, \dots, J; \quad i=1, \dots, I \tag{7}$$

$$D_j^- = \sqrt{\sum_{i=1}^n (v_{ij} - v_i^-)^2} \quad j=1, \dots, J; \quad i=1, \dots, I \tag{8}$$

where, D_j^* is the distance of each the normalized weighted decision matrix from positive ideal solution and D_j^- shows the distance of each the normalized weighted decision matrix from negative ideal solution and

(6) Calculate the relative closeness to the ideal solution.

$$C_j^* = D_j^- / (D_j^- + D_j^*) \quad j=1, \dots, J; \quad i=1, \dots, I$$

(9)

where, C_j^* is the relative closeness to the ideal solution, D_j^* represents N-dimensional Euclidean distance for positive ideal solution, and D_j^- shows N-dimensional Euclidean distance for negative ideal solution.

(7) The ranking order of all alternatives is determined in the final stage according to the relative closeness.

4. Result

According to explanation above, for using TOPSIS method for selecting the most appropriate model, two matrixes need as: decision matrix and weighted matrix.

The Matrix D was constructed as the Decision Matrix based on the most representative models in measuring the service quality. The all collected items from three models were described in section two. While several same items proposed with these models, the similar items were integrated to one item. Finally, thirty seven different items presented by these models were found. As shown in the matrix (D), decision matrix was constructed based on the PZB, Y&G and D&J models and also the collected different items presented by these models. Then the decision matrix was evaluated based on binary value, if the item was presented by the model, it was rated as one otherwise it was rated as zero. According to TOPSIS method, in addition of decision matrix, it is needed to propose the weighted matrix, to weight each collected items. As a result, Lawshe's method was utilized for making the weighted matrix. Based on Lawshe's method, experts should judge about each item in a format of three-options. These options are "Essential or Highly Relevant," "Useful but Not Essential or Relevant" and "Not necessary or Least Relevant." Then, the number of experts who responses to option "essential" are put the following Eq. 10 for estimating the content validity ratio (CVR). If the estimated coefficient of each item is higher than the standardized values by Lawshe's table, item has content validity, otherwise, this item doesn't have content validity. (According to CVR table, while the number of experts is 30 the Min Value of CVR should be 0.33), CVR Eq. 10 is as follows:

$$CVR = (n_e - (N/2)) / (N/2) \tag{10}$$

In which, n_e is the number of experts that selecting option "essential" and N is the total number of experts that provide themselves comments.

Table 1: Number of experts that provide themselves comments

	PZB	D&J	Y&G	Item of Service Quality
	1	0	0	The service dealers have modern-looking equipment.
	1	0	1	The physical facilities are visually appealing in dealer's shop.
	1	0	1	Employees appear neatly at work.

	1	0	0	Materials associated with service visually appealing at workplace.
	1	1	0	The service dealers always keep their promises to customers.
	1	0	0	The service dealers always show interests in customers' needs
	1	1	0	The service dealers perform their services right at the first time.
	1	1	0	The service dealers provide their services in their promised time.
	1	1	0	The service dealers endeavor on error-free records
	1	0	0	Employees are aware of the time period a job can be done.
	1	0	1	Employees are able to provide efficient service to customers.
	1	1	0	Employees are willing to help customers when there is a need.
	1	0	0	Employees always try to respond to customers' requests promptly.
	1	0	0	Employees' working style enhances customer's confidence.
	1	0	0	Customers feel safe and comfortable in their transactions.
	1	1	1	Employees always are consistently courteous to customers.
	1	0	1	Employees have the knowledge to answer customer's questions.
	1	1	0	The service dealers give individual customer attention.
D=	1	0	0	The service dealers make convenient operating hours to customers.
	1	0	0	The dealers will organize employees to attend to individual customer.
	1	0	0	Excellent service dealers will have the customers' best interest in heart.
	1	0	0	The employees will understand the specific needs of their customers.
	0	0	1	Performance quality of the whole vehicle
	0	0	1	Replacing quality of the spare-parts
	0	0	1	Diversifying service to enhance ascription degree
	0	0	1	Enthusiastic degree to pre-sale counseling
	0	0	1	Service attitude and service quality during the sale
	0	0	1	Returning visit after sale and maintenance
	0	0	1	Basic service establishment: tea, sofa, magazines, etc.
	0	1	1	Returning visit after sale and maintenance
	0	1	0	Providing alternative vehicles
	0	1	0	The interpretation before the work
	0	1	0	Informing the costs before the work
	0	1	0	Correctly estimating the cost
	0	1	0	Actively interpreting the list
	0	1	0	The waiting time of sending and taking the car for taking away
	0	1	0	The waiting time of sending and taking the car for getting back
	0	1	0	The car is neat

Notably, some researchers modified Likert's response structure (Henderson & Freeman, 1987) or other response structure with the numerical continuum based on Lawshe's criteria (Hassanzadeh et al., 2012). In this regard, in the first step, the experts' numerical responses of each item were converted to the format of Lawshe's three-point ordinal scale. Next, content validity ratio (CVR) was computed for each item based on Lawshe's formula.

Table 2 shows Lawshe's criteria and numerical responses matched with these. By using Lawshe's method, the CVR was calculated for each selected item, the results are presented in Table 3. The last column of Table 3 illustrates the CVR value for each thirty seven items. According to Table 3 and calculated CVR for each item, the weighted matrix was made, are presented in Table 4.

Table 2: Matching lawshe's criteria with numerical experts' response

Numerical Responses	Instead of	Lawshe's Criteria**
5 & 6	→	being essential or (highly relevant)
3 & 4	→	being useful, but no essential relevant
1 & 2*	→	being unnecessary least relevant

Table 3: Service quality items of PZB, D&J and Y&G models

Items of Service Quality Measurement	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	Total of Experts	CVR
The service dealers have modern-looking equipment.	10	6	7	4	1	2	30	0.07
The physical facilities are visually appealing in dealer's shop.	10	16	1	1	1	0	30	0.73

** The smallest experts' numerical answer was 2. So, this number was considered as the lowest score. Then numbers of score were divided into three groups. Each group covers three-score.
 If fewer than half experts choose, "highly relevant," the CVR is negative
 If half experts choose, "highly relevant" and half do not, the CVR is zero. If all experts choose, "highly relevant" the CVR is equal 1. If more than half experts choose, "highly relevant," the CVR is between zero and 0.99.

Items of Service Quality Measurement	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	Total of Experts	CVR
Employees appear neatly at work.	6	22	0	2	0	0	30	0.87
Materials associated with service visually appealing at workplace.	10	9	5	3	3	0	30	0.27
The service dealers always keep their promises to customers.	10	11	6	1	1	1	30	0.40
The service dealers always show interests in customers' needs	10	9	8	0	2	1	30	0.27
The service dealers perform their services right at the first time.	12	12	3	2	1	0	30	0.60
The service dealers provide their services in their promised time.	15	6	4	1	3	1	30	0.40
The service dealers endeavor on error-free records	16	8	6	0	0	0	30	0.60
Employees are aware of the time period a job can be done.	8	11	2	2	4	3	30	0.27
Employees are able to provide efficient service to customers.	14	13	1	1	1	0	30	0.80
Employees are willing to help customers when there is a need.	13	12	1	2	0	2	30	0.67
Employees always try to respond to customers' requests promptly.	11	7	7	2	2	1	30	0.20
Employees' working style enhances customer's confidence.	12	10	5	1	1	1	30	0.47
Customers feel safe and comfortable in their transactions.	7	14	7	0	1	1	30	0.40
Employees always are consistently courteous to customers.	13	16	1	0	0	0	30	0.93
Employees have the knowledge to answer customer's questions.	12	11	6	1	0	0	30	0.53
The service dealers give individual customer attention.	12	10	5	2	1	0	30	0.47
The service dealers make convenient operating hours to customers.	10	12	3	3	1	1	30	0.47
The dealers will organize employees to attend to individual customer.	10	11	4	5	0	0	30	0.40
Excellent service dealers will have the customers' best interest in heart.	13	11	2	2	2	0	30	0.60
The employees will understand the specific needs of their customers.	7	12	7	3	1	0	30	0.27
Performance quality of the whole vehicle	12	14	2	0	1	1	30	0.73
Replacing quality of the spare-parts	11	16	2	1	0	0	30	0.80
Diversifying service to enhance ascription degree	13	15	1	1	0	0	30	0.87
Enthusiastic degree to pre-sale counseling	9	9	9	1	1	1	30	0.20
Service attitude and service quality during the sale	14	10	3	1	2	0	30	0.60
Basic service establishment: tea, sofa, magazines, etc.	16	10	1	2	1	0	30	0.73
Returning visit after sale and maintenance	10	11	3	4	2	0	30	0.40
Providing alternative vehicles	19	7	2	2	0	0	30	0.73
The interpretation before the work	12	12	3	2	0	1	30	0.60
Informing the costs before the work	12	13	1	1	1	2	30	0.67
Correctly estimating the cost	8	16	2	1	2	1	30	0.60
Actively interpreting the list	9	11	3	3	2	2	30	0.33
The waiting time of sending and taking the car for taking away	7	9	5	3	3	3	30	0.07
The waiting time of sending and taking the car for getting back	10	6	3	5	4	2	30	0.07
The car is neat	10	14	2	3	0	1	30	0.60

Table 4: The weighted matrix was made

0.07	The service dealers have modern-looking equipment.
0.73	The physical facilities are visually appealing in dealer's shop.
0.87	Employees appear neatly at work.
0.27	Materials associated with service visually appealing at workplace.
0.40	The service dealers always keep their promises to customers.
0.27	The service dealers always show interests in customers' needs
0.60	The service dealers perform their services right at the first time.
0.40	The service dealers provide their services in their promised time.
0.60	The service dealers endeavor on error-free records
0.27	Employees are aware of the time period a job can be done.
0.80	Employees are able to provide efficient service to customers.
0.67	Employees are willing to help customers when there is a need.
0.20	Employees always try to respond to customers' requests promptly.
0.47	Employees' working style enhances customer's confidence.
0.40	Customers feel safe and comfortable in their transactions.
0.93	Employees always are consistently courteous to customers.
0.53	Employees have the knowledge to answer customer's questions.
0.47	The service dealers give individual customer attention.

W=CVR=	0.47	The service dealers make convenient operating hours to customers.
	0.40	The dealers will organize employees to attend to individual customer.
	0.60	Excellent service dealers will have the customers' best interest in heart.
	0.27	The employees will understand the specific needs of their customers.
	0.73	Performance quality of the whole vehicle
	0.80	Replacing quality of the spare-parts
	0.87	Diversifying service to enhance ascription degree
	0.20	Enthusiastic degree to pre-sale counseling
	0.60	Service attitude and service quality during the sale
	0.73	Returning visit after sale and maintenance
	0.40	Basic service establishment: tea, sofa, magazines, etc.
	0.73	Returning visit after sale and maintenance
	0.60	Providing alternative vehicles
	0.67	The interpretation before the work
	0.60	Informing the costs before the work
	0.33	Correctly estimating the cost
	0.07	Actively interpreting the list
	0.07	The waiting time of sending and taking the car for taking away
	0.60	The waiting time of sending and taking the car for getting back
	0.07	The car is neat

After constructing decision and weighted matrix, the TOPSIS procedure was followed to select the most appropriate measurement model of service quality.

First the normalized decision matrix should be multiple with the weighted matrix to construct the weighted normalized decision matrix. Because the decision matrix was constructed based on binary values the normalized decision matrix was the same. It means that our proposed decision matrix was normalized. Thereby, in this step the weighted decision matrix is calculated as follows:

$$V_{ij} = ND_{ij} \times W_j, \quad j=1, \dots, J; \quad i=1, \dots, I \quad (11)$$

Where, D shows the constructed decision matrix and W represents the presented weighted matrix.

The result of calculating the Eq. 11 made the normalized weighted decision matrix as:

$$V = \begin{matrix} & \begin{matrix} PZB \\ D \ \& \ J \\ Y \ \& \ G \end{matrix} \\ \begin{matrix} PZB \\ D \ \& \ J \\ Y \ \& \ G \end{matrix} & \begin{bmatrix} 10.667 \\ 6.333 \\ 8.2 \end{bmatrix} \end{matrix} \quad (12)$$

Then, the distances of the normalized weighted decision matrix from the positive ideal solution and negative ideal solution evaluated. Since the positive ideal solution for each item was one, it means the all of the collected items was presented by the model, in contract the negative ideal solution accrued when none of the collected item was presented by the model, so the negative ideal solution was (-37).

The distance of each normalized weighted decision matrix element from the positive ideal solution and negative ideal solution were computed as:

$$D_{PZB}^* = \sqrt{(v_{i,PZB} - v_i^*)^2} = \sqrt{(10.667 - 37)^2} = 26333 \quad (13)$$

$$D_{D\&J}^* = \sqrt{(v_{i,D\&J} - v_i^*)^2} = \sqrt{(6.333 - 37)^2} = 30667 \quad (14)$$

$$D_{Y\&G}^* = \sqrt{(v_{i,Y\&G} - v_i^*)^2} = \sqrt{(8.2 - 37)^2} = 28.8 \quad (15)$$

where, D_{PZB}^* shows the distance of PZB Model from positive ideal solution, $D_{D\&J}^*$ represents the distance of D&J Model from positive ideal solution, and $D_{Y\&G}^*$ denotes the distance of Y&G Model from positive ideal solution.

$$D_{PZB} = \sqrt{(v_{i,PZB} - v_i)^2} = \sqrt{(10.667 - (-37))^2} = 47.667 \quad (16)$$

$$D_{D\&J} = \sqrt{(v_{i,D\&J} - v_i)^2} = \sqrt{(6.333 - (-37))^2} = 43.333 \quad (17)$$

$$D_{Y\&G} = \sqrt{(v_{i,Y\&G} - v_i)^2} = \sqrt{(8.2 - (-37))^2} = 45.2 \quad (18)$$

where, D_{PZB} shows the distance of PZB Model from negative ideal solution, $D_{D\&J}$ represents the distance of D&J Model from negative ideal solution, $D_{Y\&G}$ and denotes the distance of Y&G Model from negative ideal solution.

Finally, to find the most appropriate model, the relative closeness to the ideal solution is calculated as follows:

$$C_{PZB}^* = D_{PZB}^- / (D_{PZB}^- + D_{PZB}^*) = (47.667 / 47.667 + 26.333) = 0.644 \quad (19)$$

$$C_{D\&J}^* = D_{D\&J}^- / (D_{D\&J}^- + D_{D\&J}^*) = (43.333 / 43.333 + 30.667) = 0.586 \quad (20)$$

$$C_{Y\&G}^* = D_{Y\&G}^- / (D_{Y\&G}^- + D_{Y\&G}^*) = (45.2 / 45.2 + 28.8) = 0.613 \quad (21)$$

By ordering the Eq. 19 Eq. 20, and Eq. 21 the final result of TOPSIS method was discovered as:

$$C_{PZB}^* < C_{Y\&G}^* < C_{D\&J}^* \quad (22)$$

The result showed that the relative closeness of PZB Model is higher than others and the relative closeness of D&J Model is the least. Therefore,

TOPSIS method indicates that PZB Model is the most appropriate model for measuring the service quality.

[Oliver \(2010\)](#) explained that quality improvement is the key factor that affects customer satisfaction and increases purchase intention among consumers. Marketing researchers have paid more attention towards measurement of service/product quality to understand customer satisfaction. Both researchers and practitioners give more weightage to customer satisfaction, because, a high degree of customer satisfaction can lead to customer retention and increased market share ([Subramanian et al., 2014](#); [Yüksel & Yüksel, 2003](#)). According to [Yu and Shi \(2013\)](#), [Chan and Yazdanifard \(2014\)](#), and [Huber, Herrmann, and Hoyer \(2015\)](#) customer satisfaction and company profitability are closely linked to product and service quality. Higher levels of quality result in greater customer satisfaction, while at the same supporting higher price and lower cost. All these evidences lead us to measure and manage service quality appropriately.

As shown in Matrix D, PZB Model proposed twenty two items from 37 items that collected from all three models. In fact, PZB Model presented more critical items with high CVR weighted. This led to selection of this model as the most appropriate measurement model between these three models. On the other hand, Y&G Model involves fewer items than PZB and D&J Model, but TOPSIS indicated that Y&G Model presented more appropriate measurement method than D&J Model. The reason is that the items proposed by Y&G Model had higher CVR values. As a result, this study revealed that the number of items which considered for measuring the service quality by a model is not enough to verify that model is appropriate for measurement the service quality. In fact, the CVR weighted of each item effects on the accuracy of measuring the service quality, since CVR weighted is based on the expert rates for each item. Therefore, if the proposed model considered the vital items for measuring the service quality in the view of experts, the model is more appropriate to be applied in each specific industry.

5. Discussion

The significance of findings the appropriate method of measuring service quality is defined by influences on essential variables which are important for each company. The appropriate service quality measurement derives to satisfy customers more. [Oliver \(2010\)](#) explained that quality improvement is the key factor that affects customer satisfaction and increases purchase intention among consumers. Marketing researchers have paid more attention towards measurement of service/product quality to understand customer satisfaction. Both researchers and practitioners give more weightage to customer satisfaction, because, a high degree of customer satisfaction can lead to customer loyalty and increased market share ([Subramanian et al., 2014](#); [Yüksel & Yüksel, 2003](#)). According to [Yu and Shi \(2013\)](#), [Chan and](#)

[Yazdanifard \(2014\)](#), and [Huber et al. \(2015\)](#) customer satisfaction and company profitability are closely linked to product and service quality. Higher levels of quality result in greater customer satisfaction, while at the same supporting higher price and lower cost. All these evidences lead us to measure and manage service quality appropriately. [Santouridis and Trivellas \(2010\)](#) argue that customer satisfaction can be attained by enterprises, which have understood their customers' needs and make every plan to provide services in an efficient and effective manner ([Harris & Harrington, 2000](#)). Consequently, service quality is clearly linked to customer satisfaction. Most researchers who investigated this relationship found this fact that service quality constitutes an important determinant of customer satisfaction ([Cronin Jr & Taylor, 1992](#); [Hallowell, 1996](#)). In this regard, to define the antecedents of customer loyalty, several researchers have looked at customer satisfaction as most important antecedent of loyalty ([Jones & Sasser Jr, 1995](#); [Sheth & Sisodia, 1999](#)).

The final target for enterprises is to create customer loyalty ([Eakuru & Mat, 2008](#); [Reinchheld, 1996](#)). Customer loyalty, a main factor, has been concerned with the probability of making business referrals, a customer returning, providing strong word-of-mouth, as well as providing references and publicity ([Bowen & Shoemaker, 1998](#); [Tam, 2004](#)). [Sheth and Parvatiyar \(1995\)](#) proposed the relational perspective as the integration of the customer in the process of management to improve marketing effort productivity. In addition, some studies have argued that this perspective is not only profitable but also this is an important source of competitive advantages ([Abdullah, Suhaimi, Saban, & Hamali, 2011](#); [Gebauer, Gustafsson, & Witell, 2011](#)).

In general, perceived service quality and customer satisfaction are evaluation variables that relate to customers' judgment about a product or service ([Ograjensek et al., 2012](#)). Results of empirical studies have shown that these are two distinct constructs ([Oliver Richard, 1997](#); [Taylor & Baker, 1994](#)) and that there exists a causal relationship between them ([Ansari et al., 2013](#); [Kassim & Abdullah, 2010](#); [Salini & Kenett, 2009](#)). According to the service profit chain ([Heskett & Schlesinger, 1994](#)), increased service quality and customer satisfaction can improve profitability through increased customer loyalty, which is a multidimensional construct, with behavioral and attitudinal dimensions being most widely recognized ([Velázquez et al., 2011](#)).

The functional form of relationships between service quality, customer satisfaction, and customer loyalty, is not just a theoretical question but has a strong impact on the effectiveness of measures undertaken by companies to improve customer satisfaction and customer loyalty. Therefore, to properly target the limited funds of companies in the field of quality management and customer management, a detailed understanding of these relationships is of vital importance. From the various

functional forms of relationships between service quality, customer satisfaction and customer loyalty, various recommendations can be obtained for use in practice (Ażman & Gomiš ek, 2014). Moreover, customer satisfaction is an important factor of marketing strategies that has been shown to be related with improved outcomes for the firm like greater market share and higher profitability (Lewis & Mazvancheryl, 2011). Managers believe that increasing customer satisfaction is an appropriate strategy for improving market share (Morgan et al., 2005; Rego et al., 2013).

6. Conclusions

Automobile industry is one of the competitive and growing industries of any economy. The technological advancement of this area have improved product performance but the customer satisfaction is also result of after sales service provided by the automobile service center, so it is necessary to pay attention to quality of service and the issues related to measure it appropriately. This study was attempted to propose a new method to select the most appropriate measurement model among various models of service quality such as PZB, D&J and Y&G.

In this study, three famous models, PZB, D&J and Y&G, in measuring service quality were analyzed and thirty seven items were collected from these models. Then, the experts were asked to rate each of the collected items. Considering the rates of experts the CVR of each item was computed. Next, the most appropriate measurement model was selected by using TOPSIS method. To implement the TOPSIS method, two matrixes were constructed, first was decision matrix, which was made by the relationship between model and their proposed items, and second was weighted matrix, which was based on calculated CVR values for each item.

The result of TOPSIS method indicated that the PZB is the most appropriate model for applying in measurement of service quality. PZB model included more items in which its proposed items had higher CVR values. Y&G showed better result than D&G. However Y&G presented fewer items compared to both PZB and D&G, its proposed items had higher CVR values than D&G. Thereby, this revealed that the CVR has an effective role in selecting an appropriate model, since CVR is computed based on the rate of experts, applying the items with higher CVR lead to better measurement compare to considering more items with less CVR. This result derived a model for measuring service quality based on the essential items collected from PZB, D&J and Y&G which had higher CVR value than 0.33.

This research supports other researchers to extend this method to compare their models with other existing measurement models in service quality and investigate the CVR of their proposed items. On the other hand, the industries which interests to find the best measurement method not only for service quality, but also for product quality

can apply this method. In fact, each industry can select the most appropriate measurement model with evaluation CVR of the collected items by the experts, who are professional in that industry,

Future studies could aim to extend and improve the application of propose method by incorporating other variables such as perceived value or satisfaction to find the most appropriate measurement model of each industry. Another point to be considered is the method which can be employed for other industries to find the appropriate measurement of each specific variable.

References

- Abdullah, F., Suhaimi, R., Saban, G., & Hamali, J. (2011). Bank service quality (BSQ) index: an indicator of service performance. *International Journal of Quality & Reliability Management*, 28(5), 542-555.
- Ansari, A., Kheirabadi, A., Ghalamkari, S., & Khanjari, A. (2013). Investigation the Relationship among Mobile Value-added Services Quality, Customer Satisfaction and the Continuance Intention: Case Study, Hamrah Avval Operator. *International Journal of Information Science and Management (IJISM)*, 67-84.
- Ażman, S., & Gomiš ek, B. (2014). Functional form of connections between perceived service quality, customer satisfaction and customer loyalty in the automotive servicing industry. *Total Quality Management & Business Excellence*(ahead-of-print), 1-17.
- Bowen, J. T., & Shoemaker, S. (1998). Loyalty: A strategic commitment. *Cornell Hotel and Restaurant Administration Quarterly*, 39(1), 12-25.
- Chan, J. M., & Yazdanifard, R. (2014). How Social Media Marketing can Influence the Profitability of an Online Company From a Consumer Point of View. *Journal of Research in Marketing*, 2(2), 157-160.
- Chou, C.-C., Liu, L.-J., Huang, S.-F., Yih, J.-M., & Han, T.-C. (2011). An evaluation of airline service quality using the fuzzy weighted SERVQUAL method. *Applied Soft Computing*, 11(2), 2117-2128.
- Cronin Jr, J. J., & Taylor, S. A. (1992). Measuring service quality: a reexamination and extension. *The Journal of Marketing*, 55-68.
- Cronin Jr, J. J., & Taylor, S. A. (1994). SERVPERF versus SERVQUAL: reconciling performance-based and perceptions-minus-expectations measurement of service quality. *The Journal of Marketing*, 125-131.
- Crosby, P. (1984). Paper presented to the "Bureau de Commerce". *Montreal, Canada (Unpublished), November*.

- Dabholkar, P. A., Shepherd, C. D., & Thorpe, D. I. (2000). A comprehensive framework for service quality: an investigation of critical conceptual and measurement issues through a longitudinal study. *Journal of retailing*, 76(2), 139-173.
- Dai, J., & Jiang, Y. (2012). *The Evaluation of After-sales Service Quality of Cars Based on AHP-BP*. Paper presented at the Intelligent Computation Technology and Automation (ICICTA), 2012 Fifth International Conference on.
- Eakuru, N., & Mat, N. K. N. (2008). The application of structural equation modeling (SEM) in determining the antecedents of customer loyalty in banks in South Thailand. *The Business Review, Cambridge*, 10(2), 129-139.
- Gebauer, H., Gustafsson, A., & Witell, L. (2011). Competitive advantage through service differentiation by manufacturing companies. *Journal of Business Research*, 64(12), 1270-1280.
- Gonzalez, M. E., Mueller, R. D., & Mack, R. W. (2008, p230). An alternative approach in service quality: an e-banking case study.
- Grönroos, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing*, 18(4), 36-44.
- Hallowell, R. (1996). The relationships of customer satisfaction, customer loyalty, and profitability: an empirical study. *International Journal of Service Industry Management*, 7(4), 27-42.
- Harris, M., & Harrington, H. J. (2000). Service Quality in the knowledge age: huge opportunities for the twenty-first century. *Measuring Business Excellence*, 4(4), 31-36.
- Hassanzadeh, N., Alhyary, T., Khosravi, Y., Pilgrim, F., & Saremi, M. (2012). Designing questionnaire of occupational cognitive failures: to determine the validity and reliability of instruments. *Iran Occupational Health Journal*, 9-1(1735-5133).
- Henderson, M., & Freeman, C. P. (1987). A self-rating scale for bulimia. The 'BITE'. *The British Journal of Psychiatry*, 150(1), 18-24.
- Heskett, J. L., & Schlesinger, L. (1994). Putting the service-profit chain to work. *Harvard business review*, 72(2), 164-174.
- Huber, F., Herrmann, A., & Hoyer, W. (2015). *Competition, Satisfaction and Loyalty As Determinants of the Profitability in the Car Retailing Industry-Results of An Empirical Study*. Paper presented at the Proceedings of the 2000 Academy of Marketing Science (AMS) Annual Conference.
- Hwang, C.-L., Paidy, S. R., Yoon, K., & Masud, A. S. M. (1980). Mathematical programming with multiple objectives: A tutorial. *Computers & Operations Research*, 7(1), 5-31.
- Jain, S. K., & Gupta, G. (2004). Measuring service quality: SERVQUAL vs. SERVPERF scales. *Vikalpa*, 29(2), 25-37.
- Jones, T. O., & Sasser Jr, W. E. (1995). Why Satisfied Customers Defect", *Harvard Business Review*, Nov./Dec. 1995.
- Juran, J. M. (1988). *Juran on planning for quality*: Free Press New York, NY.
- Kassim, N., & Abdullah, N. A. (2010). The effect of perceived service quality dimensions on customer satisfaction, trust, and loyalty in e-commerce settings: a cross cultural analysis. *Asia Pacific Journal of Marketing and Logistics*, 22(3), 351-371.
- Lai, Y.-J., Liu, T.-Y., & Hwang, C.-L. (1994). Topsis for MODM. *European Journal of Operational Research*, 76(3), 486-500.
- Langeard, E., & Eiglier, P. (1987). Servuction: le marketing des services. *Gebauer, H. Johnson, M. and Enquist, B (2010) "Value Co-creation as a determinant a of success in public transport services. A study of the Swiss federal Railway operators (SBB)". Managing Service Quality*, 20(6), 511-530.
- Lassar, W. M., Manolis, C., & Winsor, R. D. (2000). Service quality perspectives and satisfaction in private banking. *Journal of Services Marketing*, 14(3), 244-271.
- Lewis, H. F., & Mazvanchery, S. K. (2011). A model for efficiency analysis of the customer satisfaction process.
- Morgan, N. A., Anderson, E. W., & Mittal, V. (2005). Understanding firms' customer satisfaction information usage. *Journal of marketing*, 69(3), 131-151.
- Muhammad Butt, M., & Cyril de Run, E. (2010). Private healthcare quality: applying a SERVQUAL model. *International journal of health care quality assurance*, 23(7), 658-673.
- Ograjenšek, I., Gal, I., Kenett, R., & Salini, S. (2012). The concept and assessment of customer satisfaction. *Modern analysis of customer surveys: With applications using R*, 107-127.
- Oliver Richard, L. (1997). Satisfaction: A behavioral perspective on the consumer. *New York ' NY: Irwin-McGraw-Hill*.
- Oliver, R. L. (2010). *Satisfaction: A behavioral perspective on the consumer*: ME Sharpe.
- Olson, D. L. (2004). Comparison of weights in TOPSIS models. *Mathematical and Computer Modelling*, 40(7), 721-727.
- Pakdil, F., & Aydın, Ö. (2007). Expectations and perceptions in airline services: An analysis using weighted SERVQUAL scores. *Journal of Air Transport Management*, 13(4), 229-237.

- Parasuraman, A., Zeithaml, V., & Berry, L. (1988). Refinement and reassessment of the SERVQUAL scale.
- Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *The Journal of Marketing*, 41-50.
- Parkan, C., & Wu, M. (1997). On the equivalence of operational performance measurement and multiple attribute decision making. *International Journal of Production Research*, 35(11), 2963-2988.
- Rego, L. L., Morgan, N. A., & Fornell, C. (2013). Reexamining the market share-customer satisfaction relationship. *Journal of marketing*, 77(5), 1-20.
- Reinhold, F. (1996). The loyalty effect: the hidden force behind growth, profits, and lasting value. *Long Range Planning*, 29(6), 909-909.
- Rod, M., Ashill, N. J., Shao, J., & Carruthers, J. (2009). An examination of the relationship between service quality dimensions, overall internet banking service quality and customer satisfaction: A New Zealand study. *Marketing Intelligence & Planning*, 27(1), 103-126.
- Roshnee Ramsaran-Fowdar, R. (2008). The relative importance of service dimensions in a healthcare setting. *International journal of health care quality assurance*, 21(1), 104-124.
- Rust Roland, T., & Oliver, R. L. (1994). *Service Quality: Insights and Managerial Implication from the Frontier* New York: Sage Publications.
- Salini, S., & Kenett, R. S. (2009). Bayesian networks of customer satisfaction survey data. *Journal of Applied Statistics*, 36(11), 1177-1189.
- Santouridis, I., & Trivellas, P. (2010). Investigating the impact of service quality and customer satisfaction on customer loyalty in mobile telephony in Greece. *The TQM Journal*, 22(3), 330-343.
- Sheth, J. N., & Parvatlyar, A. (1995). Relationship marketing in consumer markets: antecedents and consequences. *Journal of the academy of marketing science*, 23(4), 255-271.
- Sheth, J. N., & Sisodia, R. S. (1999). Revisiting marketing's lawlike generalizations. *Journal of the academy of marketing science*, 27(1), 71-87.
- Sohn, C., & Tadisina, S. K. (2008). Development of e-service quality measure for internet-based financial institutions. *Total Quality Management*, 19(9), 903-918.
- Strombeck, S., & Shu, S.-T. (2014). Modeling contextually elicited service quality expectations. *Managing Service Quality*, 24(2), 160-183.
- Subramanian, N., Gunasekaran, A., Yu, J., Cheng, J., & Ning, K. (2014). Customer satisfaction and competitiveness in the Chinese E-retailing: Structural equation modeling (SEM) approach to identify the role of quality factors. *Expert Systems with Applications*, 41(1), 69-80.
- Tam, J. L. (2004). Customer satisfaction, service quality and perceived value: an integrative model. *Journal of marketing management*, 20(7-8), 897-917.
- Taylor, S. A., & Baker, T. L. (1994). An assessment of the relationship between service quality and customer satisfaction in the formation of consumers' purchase intentions. *Journal of retailing*, 70(2), 163-178.
- Velázquez, B. M., Saura, I. G., & Molina, M. E. R. (2011). Conceptualizing and measuring loyalty: Towards a conceptual model of tourist loyalty antecedents. *Journal of Vacation Marketing*, 17(1), 65-81.
- Yan, B., & McLaren, P. (2010). *Measuring after-sales service quality in automobile retails: An application of the SERVQUAL instruments*. Paper presented at the Industrial Engineering and Engineering Management (IEEM), 2010 IEEE International Conference on.
- Yoon, K. P., & Hwang, C.-L. (1995). *Multiple attribute decision making: an introduction* (Vol. 104): Sage Publications.
- Yu, Y., & Shi, Z. (2013). Customer satisfaction in the fashion industry: Case study of HM case company.
- Yüksel, A., & Yüksel, F. (2003). Measurement of tourist satisfaction with restaurant services: A segment-based approach. *Journal of Vacation Marketing*, 9(1), 52-68.
- Yun, C., & Guo-ping, C. (2012). *Research on Service Quality Evaluation Method of Automobile 4S Stores*. Paper presented at the Business Computing and Global Informatization (BCGIN), 2012 Second International Conference on.
- Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2006). *Services marketing: Integrating customer focus across the firm*.